# RESEARCHES FOR ESTSBLISHING THE ELEMENTS NEEDED FOR IRRIGATION SCHEDULING IN PEACH-TREE BY DRIP AND MICROSPRINKLER METHODS

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***Abstract***

*The paper presents the results obtained during 2000-2008 in Oradea in an experiment with drip and micro sprinkler irrigation in peach-tree. Peach trees water consumption from the variant studied where compared four reference evapotranspiration dermined by Thornthwaite, pan Class A, Piche evaporimeter, Penman-Monteith methods. There is a specific situation regarding the peach-tree, the water consumption and the values of the reference evapotranspiration. The results obtained underline the need of the crop coefficient use for the reference evapotranspiration transformation into peach-tree optimum water consumption.*

**Keywords:** peach tree, water consumption, crop coefficient, irrigation scheduling

## INTRODUCTION

Oradea peach tree basin is the second peach tree basin from Romania after the Dobrogea and before 1990 Bihor county occupied the second place on the country regarding the quantity of peach exported (Sarca Gh., 2003). The annual rainfall registered in Oradea (620 mm multiannual average) are bigger than the annual rainfall from Dobrogea, but their distribution are not according with peach water requirement and the researches made by Şcheau V. (2005), Şcheau V. and al (2006) emphasized the need of the irrigation in peach tree.

Establishing with the biggest precision of the best moment for irrigation use is very important and there are different methods for irrigation scheduling on the world. Most of them use the crop coefficient (kc) for transformation of the reference evapotranspiration in the optimum water consumption and, based on the soil water balance, when the soil water reserve on irrigation depth decrease to the easily available water content the irrigation is applied and soil water reserve increase to the field capacity. (Doorembos and Pruitt, 1992, Domuţa C., 1995, 2003, 2005)

## MATERIALS AND METHODS

The researches were carried out in an orchard planted in 1996. The cultivar used was Superb of Autumn. The peach-tree water consumption was obtained using the soil water balance method; the depth of the water balance was of 0-150 cm. Three variants were studied: 1) Nonirrigated; 2) Drip irrigated 3) Micro sprinkler irrigated. In the irrigated variant, the soil water reserve on 0-150 cm was maintained between the easily available water content and the field capacity determining the soil moisture every ten days. The irrigation regime included an irrigation rate of 376.7 mm in 2000 of 143.0 mm in 2002, 152.0 mm in 2003, of 2300 $m^3$/ha in 2004, of 2010 $m^3$/ha in 2005, of 2710 $m^3$/ha in 2006, of 3540 $m^3$/ha in 2007, of 3400 $m^3$/ha in 2008. The annual rainfall during the studied period was of 527.4 mm in 2000, of 868.5 mm in 2001, of 437.5 mm in 2002, of 501.1 mm in

2003, of 737.5 mm in 2004, of 772.0 mm in 2005, of 684.9 mm in 2006, of 556.1 mm in 2007, of 585.7 mm in 2008. The Pann class A and the Piche evaporation were determined every day at 8 o'clock by the same person. Three Pann class A and three Piche ones were used. Thorntwaite and Penman-Monteith values of the reference evapotranspiration were calculated using a known formula (Botzan, 1966, Domuța, 2005).

## RESULTS AND DISSCUSIONS

The differences between the water consumption of the peach-tree and the reference evapotranspiration ($ET_o$)

The daily water consumption of the nonirrigated peach-tree increased from April (2.43 mm/day) to June (3.66 mm/day) and decreased after that. In irrigated conditions, in both drip and micro sprinkler conditions, the maximum daily water consumption was registered a month later than in nonirrigated conditions. In irrigated conditions the values of the daily water consumption of the peach-tree were bigger than the values registered in the nonirrigated variant every month (Table 1).

In nonirrigated conditions in comparison with the peach-tree water consumption, the values obtained for the reference evapotranspiration ($ET_o$) determined by the Thorntwaite, Pann class A and Piche evaporimeters and Penman-Monteith methods present different situations. All the months, the closest values to the ETR were obtained in $ET_o$ Thorntwaite, in April, May, June and July the differences were insignificantly and in August and September were distinguishable significant.

Table 1

Daily water consumption (ETR) and daily optimum water consumption ($ETR_{opt}$) of the peach-tree in comparison with the reference evapotranspiration ($ET_o$) determined using by different methods (mm/day), Oradea 2000-2008

| Variant | April | May | June | July | August | September |
|---|---|---|---|---|---|---|
| 1.ETR | 2.43 | 3.56 | 3.66 | 3.39 | 1.62 | 1.13 |
| 2.$ETR_{opt}$ drip irrigation | 2.61 | 3.72 | 4.22 | 4.89 | 3.72 | 1.54 |
| 3.$ETR_{opt}$ micro sprinkler | 2.74 | 3.87 | 4.78 | 5.13 | 3.43 | 1.75 |
| 4.$ET_o$ Thorntwaite | 1.91 | 3.82 | 4.45 | 4.68 | 4.27 | 2.54 |
| 5.$ET_o$ Pann class A | 2.6 | 4.14 | 4.63 | 4.8 | 4.76 | 2.70 |
| 6.$ET_o$ Piche evaporimeter | 3.64 | 5.21 | 6.22 | 6.49 | 6.45 | 3.52 |
| 7.$ET_o$ Penman-Monteith | 2.56 | 4.07 | 4.92 | 4.55 | 4.67 | 2.49 |
| Statistically appreciation of the differences between ETR and $ET_o$ | | | | | | |
| LSD 5% | 0.7 | 0.9 | 1.1 | 1.3 | 1.2 | 1.0 |
| LSD 1% | 1.4 | 1.6 | 2.2 | 2.5 | 2.6 | 2.1 |
| LSD 0.1% | 3.6 | 3.9 | 4.2 | 4.7 | 4.9 | 3.9 |
| Statistically appreciation of the differences between $ETR_{opt}$ in drip irrigation and $ET_o$ | | | | | | |
| LSD 5% | 0.4 | 0.6 | 0.4 | 0.4 | 0.7 | 0.6 |
| LSD 1% | 1.2 | 1.5 | 0.9 | 1.0 | 1.4 | 1.3 |
| LSD 0.1% | 2.5 | 2.7 | 1.9 | 2.1 | 2.3 | 2.2 |
| Statistically appreciation of the differences between $ETR_{opt}$ in micro sprinkler irrigation and $ET_o$ | | | | | | |
| LSD 5% | 0.9 | 0.6 | 0.5 | 0.7 | 0.6 | 0.9 |
| LSD 1% | 2.1 | 1.5 | 1.3 | 1.5 | 1.6 | 1.6 |
| LSD 0.1% | 3.7 | 2.4 | 2.7 | 2.5 | 2.3 | 3.1 |

In comparison with $ETR_{opt}$ of the peach-tree with drip irrigation, the closest monthly values of the reference evapotranspiration were registered using the Pann class A in April, June, and July and using the Thorntwaite method in May, August and September. In comparison with $ETR_{opt}$ on the peach-tree irrigated using the micro sprinkler method, the closest values were obtained using the Thorntwaite method in May and August, the Bac evaporimeter in July, Penman-Monteith in April, June and September. This situation emphasized the statistically assured differences between ETR and $ET_{opt}$ of the peach-tree

and $ET_o$ determined using different methods and the need of the crop coefficient „Kc" use for the $ET_o$ transformation into the water consumption of the peach-tree.

The differences between the total water consumption of the peach-tree and the reference evapotranspiration ($ET_o$)

There are the differences statistically assured between peach-tree water consumption in unirrigated conditions and in drip or microsprinkler irrigation and the values of the reference evapotranspiration ($ET_o$) calculated by Thornthwaite, Pann class A, Piche evaporimeter and Penman-Monteith method. (Tab. 2).

In comparison with the water consumption of the nonirrigated peach-tree, the closest value was obtained using the Thorntwaite method; a similar situation was obtained when the values of the drip irrigated variant were compared. When the Penman-Monteith method was used, the closest value of the water consumption in micro sprinkler irrigation was obtained.

Table 2

Differences between the water consumption (ETR) of the nonirrigated peach-tree, the optimum water consumption ($ET_{opt}$) of the irrigated peach-tree and the reference evapotranspiration ($ET_o$) determined using different methods, Oradea 2000-2008

| Variant | mm/ha | % | % | % |
|---|---|---|---|---|
| 1.ETR | 551.3 | 100 | 81 | 79 |
| 2.$ETR_{opt}$ drip irrigation | 683.0 | 124 | 100 | 98 |
| 3.$ETR_{opt}$ micro sprinkler irrigation | 700.2 | 127 | 103 | 100 |
| 4.$ET_o$ Thorntwaite | 662.9 | 120 | 97 | 95 |
| 5.$ET_o$ Pann class A | 722.6 | 131 | 106 | 103 |
| 6.$ET_o$ Piche evaporimeter | 963.9 | 175 | 141 | 137 |
| 7.$ET_o$ Penman-Monteith | 711.2 | 129 | 104 | 102 |
| Statistically appreciation of the differences between ETR and $ET_o$ | | | | |
| LSD 5% | 37.0 | | | |
| LSD 1% | 72.0 | | | |
| LSD 0.1% | 137.0 | | | |
| Statistically appreciation of the differences between $ETR_{opt}$ in drip irrigation and $ET_o$ | | | | |
| LSD 5% | 21.4 | | | |
| LSD 1% | 57.0 | | | |
| LSD 0.1% | 112.0 | | | |
| Statistically appreciation of the differences between $ETR_{opt}$ in micro sprinkler irrigation and $ET_o$ | | | | |
| LSD 5% | 21.0 | | | |
| LSD 1% | 51.2 | | | |
| LSD 0.1% | 109.8 | | | |

Crop coefficient „Kc"

The data regarding the peach-tree water consumption in drip and micro sprinkler irrigation conditions and the reference evapotranspiration ($ET_o$) determined using the Thorntwaite, pan Class A, Piche and Penman-Monteith methods, permitted the calculation of the crop coefficient (Kc). These coefficients transform the reference evapotranspiration into peach-tree water consumption in drip and micro sprinkler irrigation conditions. Tables 3 and 4 present the values of the crop coefficient for every reference evapotranspiration method. These coefficients can be used in the irrigation design – Kc for $ET_o$ Thorntwaite or $ET_o$ Penman-Monteith, because the registration of the climate data includes a big number of years, or in irrigation scheduling – Kc for $ET_o$ pan Class A and Piche evaporimeter.

Irrigation scheduling

Crop coefficient determined can be used in the peach tree irrigation scheduling based on the soil water balance on the irrigation depth. Starting from initial soil water reserve, every day, in the enter, the rainfall and irrigation are added and in the exite the daily water consumption is calculated and the results is the soil water reserve at the end of the day. Only the use of the Bac evaporimeter and Piche evaporimeter offer the measured

daily data, for transformation in optimum water consumption using the crop coefficient and this is an advantaje.

Table 3

Values of the crop coefficient „Kc" for the transformation of the reference evapotranspiration ($ET_o$) in the optimum water consumption of the drip irrigated peach-tree, Oradea 2000-2008

| Method | April | May | June | July | August | September |
|---|---|---|---|---|---|---|
| 1.Thorntwaite | 1.42 | 0.98 | 1.04 | 1.03 | 1.01 | 0.78 |
| 2. Pann class A | 1.05 | 0.97 | 1.03 | 1.00 | 0.98 | 0.81 |
| 3.Piche evaporimeter | 0.74 | 0.75 | 0.77 | 0.74 | 0.55 | 0.47 |
| 4.Penman-Monteith | 1.06 | 0.94 | 0.96 | 1.06 | 0.76 | 0.69 |

Table 4

Values of the crop coefficient „Kc" for the transformation of the reference evapotranspiration ($ET_o$) in the optimum water consumption of the micro sprinkler irrigated peach-tree, Oradea 2000-2008

| Method | April | May | June | July | August | September |
|---|---|---|---|---|---|---|
| 1.Thorntwaite | 1.47 | 1.00 | 0.56 | 1.10 | 0.78 | 0.69 |
| 2. Pann class A | 1.07 | 1.09 | 1.07 | 1.06 | 0.74 | 0.65 |
| 3.Piche evaporimeter | 0.78 | 0.74 | 0.75 | 0.71 | 0.54 | 0.50 |
| 4.Penman-Monteith | 1.11 | 0.96 | 0.92 | 1.15 | 0.73 | 0.74 |

## CONCLUSIONS

The research carried out during 2000-2008 in Oradea permitted the following conclusions:

- There are different situations of the reference evapotranspiration (ETo) values in comparison with the daily water consumption of the peach-tree in drip and micro sprinkler irrigation. These situations sustain the need for the crop coefficients (Kc) use in irrigation scheduling.
- Comparing the peach-tree water consumption of the nonirrigated variant with the reference evapotranspiration values, the closest value was registered using the Thorntwaite method. In comparison with the water consumption from the variant with drip irrigation, the same situation was registered.
- In comparison with the total water consumption of the peach-tree from the variant with micro sprinkler irrigation, the closest average value was registered using the Penman-Monteith method.
- Irrigation scheduling based on the soil water balance on the irrigation depth using Pann class A or Piche evaporimeter has the avantage of the daily determination of the evaporation and offers the possibility to calculate daily soil, water reserve on the irrigation depth of the peach tree

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